

In the Claims

Claim 1 (currently amended): An ultraviolet (UV) curing method for applying UV light to UV photo initiators in UV curable ~~items comprising products, articles, inks, coatings, and adhesives, or other objects~~ on surfaces of products, articles, and other solid objects, comprising the steps of:

emitting visible light at an intensity from a set of visible light-emitting diode (LED) assemblies secured to a panel onto the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects facing the visible light and the visible light LED assemblies;

emitting a first wavelength of UV light from a first array of UV LED assemblies secured to the panel onto the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects facing the first array of UV LED assemblies and the UV light comprising the first wavelength of UV light and at the same intensity as the visible light;

emitting a second wavelength of UV light from a second array of UV LED assemblies secured to the panel onto the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects facing the second array of UV LED assemblies and the UV light comprising the second wavelength of UV light and at the same intensity as the visible UV light and the UV light comprising the second wavelength of UV light, said second array of UV LED assemblies being different than said first array of UV LED assemblies, and said second wavelength of UV Light being different than said first wavelength of UV light;

moving the panel in proximity to or adjacent the ~~UV curable items while emitting UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects while visible light is emitted from the visible light LED assemblies and UV light is emitted from the first and second arrays of UV~~ from the LED assemblies;

the surfaces of the products, articles and other solid objects facing the visible light LED assemblies and the first and second arrays of UV LED assemblies on the panel;

~~uniformly and concurrently applying and distributing the first and second wavelengths of UV light equally at the same intensity onto the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects facing the first and second arrays of UV LED assemblies secured to the panel on the UV curable items while emitting distributing~~

the visible light equally at the same intensity on the same surfaces of the products, articles and other solid objects facing the set of visible light emitting LED assemblies secured to the panel as the panel is being moved; and concurrently

uniformly curing the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects in the absence of masks, forming spacer patterns, electric circuits for printed circuit boards, dental material, water purification, and insect lights so that the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects are polymerized in an identical manner.

Claim 2 (previously presented): The UV curing method of claim 1 wherein the first and second arrays of UV LED assemblies emit UV light at wavelengths between 315 and 400 nm.

Claim 3 (previously presented): The UV curing method of claim 1 wherein the first array of UV LED assemblies emit UV light at a peak wavelength of 365 nm and the second array of UV LED assemblies emit UV light at a peak wavelength of 385 nm.

Claim 4 (currently amended): The UV curing method of claim 1 including:
_____injecting an inert gas in a space between the panel and the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects; and
_____protecting the visible light LED assemblies and the UV LED assemblies from splatter.

Claims 5-6 (canceled)

Claim 7 (previously pending): The UV curing method of claim 1 including cooling the first and second arrays of UV LED assemblies within a predetermined range with at least one heat sink, fin, or fan.

Claims 8-12 (canceled)

Claim 13 (previously presented): The UV curing method of claim 1 including varying current drawn by UV LED chips of the first and second arrays of UV LED assemblies between about 5% and about 10%.

Claims 14-15 (canceled)

Claim 16 (currently amended): An ultraviolet (UV) apparatus for applying UV light to UV photo initiators in UV curable items ~~comprising products, articles, inks, coatings, or adhesives, or other objects~~ on surfaces of products, articles or other solid objects, comprising:

a panel;

a set of visible light-emitting diode (LED) assemblies secured to said panel for emitting visible light on the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects at an intensity;

a first array of UV LED assemblies secured to said panel for emitting a first wavelength of UV light on the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects at the same intensity as the visible light emitted from the visible light LED assemblies;

a second array of UV LED assemblies secured to said panel for emitting a second wavelength of UV light on the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects at the same intensity of the visible light emitted from the visible light LED assemblies and at the same intensity as the UV light comprising the first wavelength of UV light emitted from the first array of UV LED assemblies, said second array of UV LED assemblies being different than said first array of UV LED assemblies, said first wavelength of UV light being different than said second wavelength of UV light;

a panel-moving mechanism for moving said panel in proximity to or adjacent to the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects while visible light is UV light comprising the first and second wavelengths of UV light are emitted from the visible LED assemblies and the first and second arrays of UV LED assemblies on UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects;

the surfaces of the products, articles and other solid objects facing the visible light LED assemblies and the first and second arrays of UV LED assemblies on the panel; and

a controller operatively connected to the visible LED assemblies and the first and second arrays of UV LED assemblies and the panel-moving mechanism for~~uniformly and concurrently applying and distributing~~ the first and second wavelengths of UV light from the UV LED assemblies equally onto the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~on the UV curable items while visible light is emitted distributed~~ from the visible LED assemblies as said panel is being moved to uniformly cure the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects in the absence of masks, forming spacer patterns, electrical circuits for printed wiring boards, dental material, water purification, and insect lights so that UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects are similarly polymerized.

Claim 17 (canceled)

Claim 18 (previously presented): The UV curing apparatus of claim 16 wherein the first array of UV LED assemblies emit UV light at a peak wavelength of 365 nm and the second array of UV LED assemblies emit UV light at a peak wavelength of 385 nm.

Claim 19 (currently amended): The UV curing apparatus of claim 16 including a gas injector for injecting an inert gas in a space between the panel and the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects.

Claim 20 (currently amended): The UV curing apparatus of claim 16 including a splatter resistant protective device comprising a plastic or glass sheet or plate positioned between the UV and visible light LED assemblies and the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items~~ for substantially preventing splatter from the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items~~ from contacting the UV and visible light LED assemblies.

Claim 21 (canceled)

Claim 22 (currently amended): The UV curing apparatus of claim 16 including cooling equipment for cooling the UV and visible light LED assemblies to keep the temperature of the UV and visible light LED assemblies within a predetermined range, said cooling equipment comprising a cooling device selected from the group consisting of a heat sink, fin, and fan.

Claims 23-26 (canceled)

Claim 27 (previously presented): The UV curing apparatus of claim 16 wherein the UV LED assemblies comprise large junction UV LED chips over 400 microns on a side.

Claim 28 (previously presented): The UV curing apparatus of claim 16 wherein the UV LED assemblies comprise UV LED chips with a current drain which only varies between 5% and 10%.

Claims 29-30 (canceled)

Claim 31 (currently amended): An ultraviolet (UV) curing method for applying UV light to UV photo initiators in UV curable ~~items comprising products, articles, inks, coatings, or adhesives, on surfaces of products, articles or other solid objects or other objects,~~ comprising the steps of:

emitting UV light from UV light-emitting diode (LED) chips on a substrate onto UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects;

cooling the UV LED chips with a variable speed fan and a heat sink;

moving the substrate relative to the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items;~~

sensing the light intensity of the UV light emitted from the UV LED chips;

sensing the temperature of the heat sink or UV LED chips;

adjusting and controlling the speed of the variable speed fan in response to the sensed temperature of the heat sink or UV LED chips;

maintaining the temperature of the UV LED chips at a generally constant temperature;
maintaining the light intensity of the UV light emitted ~~on-onto~~ the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items~~ at a generally constant level; the surfaces of the products, articles, or other solid objects facing the UV LED chips; and

uniformly curing the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects in a similar manner in the absence of masks, forming spacer patterns, electric circuits for printed circuit boards, dental material, water purification and insect lights, so that the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects are similarly polymerized.

Claim 32 (currently amended): An ultraviolet (UV) curing apparatus for applying UV light ~~to-onto~~ UV photo initiators in ~~UV curable items comprising products, articles, inks, coatings, or adhesives, or other object~~ on surfaces of products, articles or other solid objects, comprising:

a set of UV light-emitting diode (LED) chips mounted on a substrate for emitting UV light ~~onto-on~~ the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects;

the surfaces of the products, articles, or other solid objects facing the UV LED chips;

a heat sink mounted on said substrate for dissipating heat from said UV LED chips;

a variable speed fan mounted adjacent said heat sink for blowing air on said heat sink or UV LED chips to cool said heat sink or UV LED chips;

a moving mechanism for causing relative movement between said substrate and the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items~~;

a light sensor for sensing the intensity of UV light emitted from said UV LED chips onto the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects; and;

a control circuit coupled to said light sensor and to said variable speed fan for controlling the light intensity of the UV light emitted from said UV LED chips and the temperature of the UV LED chips by regulating the speed of the air blown by said variable speed fan on said heat sink or UV LED chips and by varying the speed of said variable speed

fan in response to the sensed intensity of the UV light to uniformly cure the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects in a similar manner in the absence of masks, forming masking patterns, electric circuits for printed wiring boards, dental material, water purification, and insect light, so that the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects are similarly polymerized.

Claim 33 (currently amended): The UV curing apparatus of claim 32 including a temperature sensor mounted adjacent said heat sink or UV LED chips and coupled to said control circuit for sensing the temperature of said heat sink or UV LED chips.

Claims 34-36 (canceled)

Claim 37 (currently amended): The UV curing apparatus of ~~claim~~ claim 32 including:
a printer with a printing head for printing UV curable ink on the ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects;

a turntable for carrying the printed UV curable items past the UV LED chips; and

a mechanism for rotating or indexing said turntable carrying the printed UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items~~ past the UV LED chips.

Claim 38 (currently amended): The UV curing apparatus of claim 32 wherein:
-said moving mechanism comprises a conveyor for moving the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects ~~UV curable items~~ past the UV LED chips as UV light is emitted from the UV LED chips on the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects.

Claim 39 (currently amended): The UV curing apparatus of claim 32 wherein said moving mechanism comprises an oscillator for oscillating or reciprocating said substrate of UV LED chips in proximity to or adjacent said ~~UV curable items~~ UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects as UV light is

emitted from said UV LED chips on the UV curable inks, coatings or adhesives on the surfaces of the products, articles or other solid objects.